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## Surgery on extremities with reflex sympathetic dystrophy

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### Chirurgie bei Extremitäten mit reflektorischer sympathetischer Dystrophie

**Zusammenfassung.** Die chirurgische Behandlung von Extremitäten mit reflektorischer sympathetischer Dystrophie (RSD) wird im allgemeinen vermieden, weil angenommen wird, daß die RSD rezidiert bzw. sich verschlimmert. Wir untersuchten unsere Patienten, um diese Annahme zu überprüfen. 47 Patienten mit RSD wurden aus verschiedenen Gründen an der affizierten Extremität operiert. Wo es möglich war, wurde die Operation solange verschoben, bis die RSD-Symptome in Ruhe abgeklungen waren und die Durchblutung sich verbessert hatte. Eine Tourniquethämostase wurde vermieden; perioperativ erhielten die Patienten eine i.v.-Mannitolinfusion. Erneutes Auftreten der RSD zeigte sich bei 6 Patienten (13%), nur bei einem Patienten in schwerer, dauerhafter, bei den übrigen 5 in milder, vorübergehender Form. Chirurgische Eingriffe an Extremitäten mit RSD sind weniger gefährlich als allgemein vermutet, aber das Risiko des Wiederauftretens der RSD ist bei geplanten Operationen stets in Betracht zu ziehen.

**Summary.** Surgery on extremities suffering from reflex sympathetic dystrophy (RSD) is generally avoided because it is presumed that RSD will recur or worsen. In order to study this problem we analyzed our patients. The affected limb of 47 patients suffering from RSD was operated on for various reasons. If possible, the operation was postponed until the signs and symptoms of RSD decreased at rest and perfusion of the affected limb was optimized; tourniquet haemostasis was avoided, and perioperative intravenous infusion of mannitol was administered. Recurrence of RSD was seen in 6 patients (13%). This recurrence was mild and temporary in 5 patients, but serious and permanent in 1 patient. Surgery on limbs suffering from RSD is not as dangerous as widely believed, but one should be aware of the risk of recurrence of RSD when surgery is being considered.

Many aspects of reflex sympathetic dystrophy (RSD) are still unknown. Complaints usually start after injury or surgery, but it is possible for other precipitating events to occur and sometimes nothing at all happens. The signs and symptoms are not necessarily related to the injury or surgery. RSD is characterized by regional pain, edema, changes in skin color and temperature, loss of function and an increase in these signs and symptoms after exercise. Other signs and symptoms, such as neurological disturbances, hyperhidrosis and atrophy of all tissues, may also occur [18]. These signs and symptoms are localized in the periphery of an extremity. As its name suggests, the sympathetic nervous system is thought to cause the syndrome, but this hypothesis has never been proven [2, 16]. Recent studies suggest that RSD is caused by an exaggerated inflammatory reaction [6, 15]. In general, physical therapy combined with blockade of the sympathetic nervous system in various ways is the therapy of choice [2]. Other therapies, e.g., corticosteroids or calcitonin, have been advocated, but no therapy has cured more than 75% of patients in a prospective controlled study. As a consequence, many patients with RSD may have complaints for many years or perhaps the rest of their lives. Besides RSD, there may be other pathological disturbances present in the affected extremity, such as neurovascular compression syndromes, trigger fingers or a neuroma [18]. These may act as triggers that maintain RSD and often need specific treatment. Surgery may be indicated, but surgeons often refrain from performing surgery on extremities with RSD because of possible recurrence or exacerbation of the RSD. However, the incidence of recurrence after operation and the results of operations on extremities suffering from RSD are unknown. Therefore, we studied our patients who were subjected to surgery on an extremity with RSD.

### Patients and methods

RSD has not been clearly defined in the literature. The criteria we use for diagnosis are summarized in Table 1. At least four of the five



**Table 1.** Diagnostic criteria

1. 4 or 5 of the following signs:
– Unexplained diffuse pain
– Difference in skin color relative to other limb
– Diffuse edema
– Difference in skin temperature relative to other limb
– Limited active range of motion
2. Occurrence or increase of above signs and symptoms after use of limb
3. Above signs and symptoms present in an area much larger than the area of primary injury or operation and including the area distal to the primary injury

following signs and symptoms should be present: unexplained diffuse pain in the extremity, definite discoloration of the skin (abnormal redness, pallor or cyanosis), diffuse edema, abnormal skin temperature and a limited active range of motion. These signs and symptoms should increase in severity after using the affected extremity. Furthermore, the above signs and symptoms should be present in an area much larger than the area of primary injury or operation and necessarily including the area distant from the primary injury. The selection criteria utilized in this study approximate those used in other studies concerning RSD and have been discussed in a previous study [18].

When surgery was indicated, we preferred to wait until the signs and symptoms of RSD decreased at rest. If skin temperature in the affected extremity was cooler than in the healthy symmetrical extremity, indicating decreased perfusion, patients were treated with peripheral vasodilators or blockade of the sympathetic nervous system to increase blood flow until skin temperature was normal. If possible, we avoided tourniquet hemostasis during surgery and started mannitol 10% 1000 ml/24 h i.v. at the time anesthesia was induced. When a minor operation in an outpatient setting was performed, mannitol was not used.

All patients were analyzed with special attention to indication for surgery, perioperative measures and outcome of surgery as well as recurrence or exacerbation of the RSD.

## Results

Forty-seven patients were operated on for various reasons: 36 were female (77%) and 11 male (23%). Age varied between 14 and 75 years (median 38). At the time of operation RSD had already been present for 3 months to 13 years (median 1.5 year).

In 14 patients one or more finger tendons were released because of stenosing tenosynovitis. In 6 patients a carpal tunnel release was performed because of the clinical signs and symptoms of carpal tunnel syndrome. All but one of these patients had impaired nerve conduction as determined by an electromyographic investigation. In 6 patients osteosynthesis implants were removed. In 4 patients a neuroma was excised. In 3 patients arthroscopy was performed for diagnostic and/or therapeutic purposes. In 2 patients an arthrodesis was performed because of severe osteoarthritis and a loosened subluxated knee prosthesis, respectively. In 2 patients partial nail extraction and nailbed fenolization were performed because of an ingrown toenail. The other patients were operated on for various reasons: excision of bursa olecrani because of recurrent inflammation, meniscectomy, arthrolysis because of joint ankylosis, and excision of a recurrent dorsal synovial cyst at the wrist (2 ×). The Hohmann opera-

**Table 2.** Operations performed and recurrences of RSD

Operation	n	Recurrence
Tendon release	14	2
Carpal tunnel release	6	2
Removal osteosynthesis material	6	
Excision of neuroma	4	
Arthroscopy	3	
Arthrodesis	2	
Removal ingrown nail	2	
Excision of tumor	2	
Excision of synovial cyst	2	
Excision of bursa olecrani	1	1
Meniscectomy	1	1
Arthrolysis	1	
Resection of 1st rib	1	
Hohmann	1	
Kuderna	1	
Total	47	6 (13%)

tion was performed because of chronic tennis elbow, the Kuderna operation because of a calcaneal fracture, excision of a benign subcutaneous tumor (2 ×) and resection of the first rib because of a thoracic outlet syndrome. Six patients were operated on with tourniquet hemostasis: one because Bier anesthesia was used and twice in arthroscopy because a bloodless field was considered necessary. In 2 patients with ingrown toenails, partial excision of the nail followed by destruction of the nailbed by phenol was performed; the success of phenolization depends on a bloodless field. In one patient osteosynthesis material was removed with tourniquet hemostasis; the protocol was not followed for unknown reasons. In none of these cases did RSD recur.

In all but two patients the aim of the operation was achieved. One patient complained of persistent pain after carpal tunnel release. Moreover, the operation was complicated by a compression neuropathy of the ulnar nerve due to insufficient positioning on the operation table as well as a mild and fortunately temporary recurrence of RSD. Another patient still complained of persistent hypesthesia in the area of the median nerve after carpal tunnel release and a temporary increase in RSD complaints.

No complications relating to the operations were seen. Recurrence of RSD after surgery occurred in six patients (13%). In five patients this recurrence was mild and temporary, and in one patient permanent and serious. The first patient developed severe RSD after a fracture of the proximal phalanx of the fifth finger. A tendon release of the flexor tendon was performed because of a tenosynovitis stenosis. After operation the trigger phenomenon was gone, but the range of motion was still limited because of joint ankylosis. One month after operation she developed a slight and temporary recurrence of RSD. The second recurrence occurred after extensor tendon release of the hand, by dividing the extensor retinaculum. After operation, a small hematoma occurred, but soon the patient developed a severe recurrence of RSD with recurrent hematomas. The third patient was relieved of a



torn meniscus, but developed a temporary recurrence of RSD. In the fourth patient, a recurrently inflamed bursa olecrani was removed; this was performed on an outpatient basis without mannitol infusion. A few days later mild and temporary exacerbation of RSD occurred. The fifth and sixth cases of recurrence occurred after carpal tunnel release and are outlined above.

## Discussion

RSD is one of many complications following operations in extremities. The development of RSD following arthroscopy, meniscectomy, joint replacement, 1st rib resection, carpal tunnel release, resection of the palmar fascia for Dupuytren's disease and amputation has been described, and probably many other operations have been complicated by RSD. The true incidence of RSD following surgery is unknown; after carpal tunnel release, RSD is seen in 2-5% [12, 13]. Many surgeons prefer not to operate on an extremity suffering from RSD to avoid a recurrence of RSD. This idea is widely accepted but rarely discussed. Evans [3] reported exacerbations of RSD after surgery or infection in 7 patients, but did not provide details. Miller et al. [14] states that "removal of a neuroma in a scar or stump hardly ever gives lasting relief unless done quite early and usually aggravates the symptoms", but reported no details. Katz et al. noted a recurrence of RSD in 8 of 17 patients (47%) who were operated because of mechanical problems in the knee [9]. Grundberg et al. [7] saw compression syndromes in 22 patients with RSD resistant to corticosteroid treatment; surgical decompression improved complaints in all patients. No remarks were made concerning eventual recurrences. Kissling et al. reported recurrences in 11 of 38 operations (29%) in a retrospective study. When calcitonin was given perioperatively as a prophylaxis of RSD, only 1 of 10 operations (10%) was followed by a recurrence of RSD [10]. In our study recurrences were seen in 13% of operations, although mild or temporary in most cases. This means that the incidence of RSD is higher probably two to three times than in patients without RSD. These data support the hypothesis that surgery in extremities suffering from RSD is accompanied by an increased risk of recurrence. This risk, however, is acceptable if the indication is carefully chosen.

## Indication for surgery

Much effort must be made to correct a painful trigger, because this may maintain the RSD. Stein [17] reported a cure of RSD after carpal tunnel release in 6 patients. Although the relationship between a cure of RSD and the surgery performed has not been clear in all patients, many patients improved after surgery.

Especially in RSD patients, the indication for operation and the benefit to be expected should be carefully weighed. In all but two patients the operation was successful, that is, trigger phenomena were gone, pain from a neuroma was gone, etc. Unfortunately, in one patient

with a blocked trigger finger, postoperative mobilization was impaired because of coexistent arthrogenic fibrosis.

On the other hand, a number of times we were requested to perform arthrodesis of the tibiotalar joint because of ankylosis in inversion. When such a patient was unable to bear weight on the affected limb or if the affected limb had to be kept in a horizontal position because complaints increased when the limb was in a dependent position, arthrodesis was not performed. Indeed, obtaining ambulation or weight bearing in this situation is impossible; thus, fixation of the tibiotalar joint in inversion, eversion or neutral position is irrelevant, making the operation obsolete.

Another aspect is the timing of surgery. Katz et al. [9] and Lankford et al. [11] waited before performing surgery until symptoms of RSD had subsided. We agree with this advice and wait until signs and symptoms of inflammation at rest have decreased and perfusion of the affected limb is optimized. In any case, surgery in a cold and/or edematous RSD limb is contra indicated.

## Perioperative measures

Whether or not perioperative measures reduce the incidence of RSD in patients without RSD is unknown. Lightman et al. [12] and Goldner [4] suggested that a careful technique, knowledge of the anatomy, and proper postoperative management could prevent RSD after carpal tunnel release. Of course, these factors are important for any operation, but their relationship to RSD has never been studied or proved and is highly questionable.

Perioperative measures to reduce exacerbation or recurrence of RSD are also unknown. Goldner [4] suggested decreasing doses of oral steroid over a period of 7 to 10 days in addition to stellate ganglion block, but did not report any results. As mentioned, Kissling reported a reduction of recurrences after calcitonin given perioperatively [10]. On theoretical grounds we operate without tourniquet hemostasis and with perioperative intravenous infusion of mannitol. We avoid using a bloodless field because RSD is characterized by a decreased extraction of oxygen from arterial blood, together with hypoxia at the cellular level, even if blood flow is increased [5, 8]. Instituting tourniquet hemostasis would increase the need for oxygen, and reperfusion would lead even further to production of toxic oxygen radicals [1]. Mannitol is a scavenger of toxic oxygen radicals, which are probably important in the pathogenesis of RSD and mannitol may be therapeutically successful [6].

From this, however, it cannot be concluded whether these perioperative measures reduce recurrence or exacerbation of RSD, because there has been no control group.

## Conclusions

Surgery in extremities suffering from RSD may provoke recurrence or exacerbation of RSD, but the risk is not as high as widely suggested. If possible, surgery should be avoided. The indication for surgery should be carefully

established. When surgery is indicated, we suggest a waiting period until the signs and symptoms have subsided. An operation without tourniquet hemostasis and with intravenous infusion of mannitol may have preventive effects, but prospective controlled studies are necessary.

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